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Teachers and the communication of climate change science: a critical partnership in Australia

Helen Boon ^{a*}

^a*School of Education, James Cook University, Townsville, Qld 4811, Australia*

Abstract

Climate change science is part of the Australian National Curriculum. Understanding current perceptions of climate change among pre-service teachers and the Australian public is important for designing effective teacher training on climate change communication. This study employed a survey to examine self-reported knowledge, beliefs and attitudes towards climate change among adults (n=1240) and pre-service teachers (n=156) in regional Australia. Results highlight knowledge and understanding gaps of climate change science in pre-service teachers and mistrust of sources of climate change information in the general public. Implications of these findings are discussed within the context of teacher training and climate science communication.

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1. Introduction

The National Curriculum Board of Australia stipulates that climate change will be taught as part of the science curriculum from primary through to secondary years [1]. Effective communication of climate change science is important not only to ensure that individuals understand the impacts of climate change but also to encourage action for climate change mitigation and adaptation. For example, many countries around the world have set ambitious targets for reduction in greenhouse gas emissions [2]. Responsibility for reduction in greenhouse gas emissions is not limited to industry but distributed across society; the Australian Government's Department of Climate Change and Energy Efficiency estimates that households account for one fifth of greenhouse gases in Australia. Consequently, the participation of individuals and households in greenhouse gases reduction is desirable if these targets are to be achieved. Similarly, individuals and households need to be responsible for adaptation to climate change in such areas as responding to and preparing for the increased threat of floods, fires and droughts in Australia as a result of climate change [3]. However, recent research has shown that people will only change their attitudes to scientific propositions like climate change when scientific consensus for the issue is widely communicated [4].

Understanding the knowledge, beliefs and attitudes towards climate change that exist among members of the general public is important in designing appropriate teacher training for educators. Equally important is examining teachers' knowledge, beliefs and attitudes towards climate change. Prior research has indicated that students in the

* Corresponding Author Helen Boon. Tel.: +61-7-4781-6030
E-mail address: helen.boon@jcu.edu.au

USA [5] and Australia [6] hold misconceptions and misunderstandings about climate change as do teachers in Australia [7]. These misconceptions and misunderstandings were probably due to, among other things, the complexity of the science involved and the controversy that surrounded these issues until recently. Given that there is empirical evidence that suggests pro-environmental behaviour is predicted by knowledge and education about the issue in debate [8], it is important that prospective teachers, who are in a position to influence their students, begin their teaching careers with a clear understanding of at least the basics of a topic as significant as climate change. Moreover, teachers need to be aware of the level of knowledge about climate change within the community particularly in order to be able to address misconceptions and uncertainties about climate change within their classrooms, since family influences can impact upon student engagement [9].

The present study employed a quantitative survey to determine self-reported knowledge, beliefs and attitudes towards climate change among the general public (n=1240) and pre-service teachers (n=156) in regional Australia.

2. Methodology

A sample of 156 final year pre-service teachers participated in this study, comprising primary education specialists (PRI), early childhood education specialists (ECE) and secondary education specialists (SEC). A survey was used to elicit participants' understanding and knowledge of climate change by examining their knowledge and ideas of the greenhouse effect, the sources of their knowledge and the actions they were prepared to undertake to mitigate their carbon footprint. The full survey has been used previously to examine a number of interrelated matters in relation to pre-service teachers' views, knowledge and beliefs [10]. Reported here are the results obtained from the following questions:

1. Greenhouse gases in the lower atmosphere (troposphere) absorb:
 - a) Incoming ultraviolet radiation
 - b) Infrared radiation emitted by the earth's land surfaces and oceans
 - c) Incoming solar radiation reflected by clouds
 - d) Incoming solar radiation across the entire electromagnetic spectrum
2. Climate Change is caused by...
 - a) A hole in the earth's atmosphere
 - b) Natural climate fluctuations
 - c) Increased cloud cover
 - d) Increased carbon emissions
3. The major source of anthropogenic carbon emissions comes from:
 - a) Using coal to generate electricity
 - b) Burning carbon containing fossil fuels and destroying forests
 - c) Increased run-off of nutrients from farmland
 - d) Increased populations of animals and humans breathing out carbon dioxide and producing methane gas

The general public survey consisted of items obtained from Reser et al. [11]. These items have a self-report Likert scale comprising of five options: Definitely Disagree, Disagree, Agree, Definitely Agree and Don't Know.

The questions were:

- a. I trust what scientists say about the environment
- b. I am concerned about climate change (global warming)
- c. I trust what the government says about the environment
- d. I trust what the media says about the environment
- e. I think climate change is caused by human activities
- f. I think climate change is a serious problem right now

The sampling adopted for the project was cluster sampling using grid points on maps to locate areas in 7 regional disaster impacted Australian communities (Ingham, Innisfail, Beechworth, Bendigo, Townville, Cairns and Mission Beach) to deliver the surveys. Surveys were hand-delivered to clusters of households in each community; they were then collected by arrangement with the householders a few days later. A total of 1240 useable surveys were

returned. The survey distribution and collection took place between October 2011 and February 2012. The statistical program IBM SPSS was employed to perform the statistical computations.

3. Results

Table 1 shows the results from the undergraduate survey of pre-service teachers. While most undergraduates answered the question about climate change correctly, the majority failed to understand the function of greenhouse gases. Moreover, the PRI and ECE groups did not understand the causes of anthropogenic climate emissions.

Table 1. Undergraduate responses

Questions	ECE	PRI	SEC
The function of greenhouse gases: incorrect	80.0%	69.0%	79.5%
The function of greenhouse gases: correct	20.0%	31.0%	20.5%
Climate change: incorrect	17.9%	29.2%	14.6%
Climate change: correct	82.1%	70.8%	85.4%
Anthropogenic climate emissions: incorrect	64.0%	60.7%	40.0%
Anthropogenic climate emissions: correct	36.0%	39.3%	60.0%

Table 2 shows the results from the survey of the general public, whose questions differed from those of the undergraduates. The results indicate that most respondents agreed or strongly agreed that climate change is a serious problem right now (58.2%) and that they are concerned about it (60.4%). Moreover, approximately half of all respondents agreed or strongly agreed that climate change is caused by human activities (52.1%). However, more respondents disagreed or strongly disagreed with the statement that they knew a lot about climate change (46.6%) than agreed with the statement (42.1%). Of interest is the lack of trust that respondents placed on sources of climate change information. Most respondents did not trust what the government (64.7%) or the media says about the environment (59.5%). Respondents were almost evenly divided in whether they trusted or did not trust scientists' communications about the environment.

Table 2. General public responses

Questions	Responses	N %
I trust what scientists say about the environment	Don't know	12.6%
	Strongly disagree	13.2%
	Disagree	31.6%
	Agree	31.2%
	Strongly agree	11.4%
I am concerned about climate change (global warming)	Don't know	8.0%
	Strongly disagree	9.2%
	Disagree	22.4%
	Agree	39.8%
	Strongly agree	20.6%
I trust what the government says about the environment	Don't know	13.1%
	Strongly disagree	25.0%
	Disagree	39.7%
	Agree	18.6%
	Strongly agree	3.6%
I feel I know a lot about climate change (global warming)	Don't know	11.2%
	Strongly disagree	7.8%
	Disagree	38.8%

	Agree	33.7%
	Strongly agree	8.4%
I trust what the media says about the environment	Don't know	11.2%
	Strongly disagree	27.7%
	Disagree	48.1%
	Agree	11.4%
	Strongly agree	1.6%
I think climate change is caused by human activities	Don't know	15.4%
	Strongly disagree	11.4%
	Disagree	21.1%
	Agree	37.5%
	Strongly agree	14.6%
I think climate change is a serious problem right now	Don't know	11.3%
	Strongly disagree	9.4%
	Disagree	21.2%
	Agree	38.5%
	Strongly agree	19.7%

4. Discussion

The above results suggest that there is a gap in pre-service teachers' knowledge and understanding of climate change. This is an important finding, not only in the context of the inclusion of climate change in the national science curriculum but also with regard to the public survey. While over half of all respondents indicated that climate change is a serious problem caused by human activities, respondents were nonetheless mistrustful of sources of climate change information and divided in their level of knowledge of climate change. It would appear that there is a gap in the communication of climate change science among the respondents interviewed. It is noted that these respondents were largely based in regional Australia; differences may emerge should the survey be replicated in metropolitan areas. It is also beyond the scope of this paper to determine whether educators will be viewed as credible sources of climate change science and whether the provision of information about climate change science to school children will influence the views of the parents and other adults in the broader community. This should, however, be the subject of further research, as the changes to the National Curriculum become implemented. Notwithstanding the above, the role of school based educators is and has been an important and influential one in rural and remote areas of Australia where teachers' views can have significant impact upon small highly interconnected communities.

Climate change science must be incorporated into pre-service teacher training if the science is to be accurately and appropriately communicated to school children and adolescents. In addition, there may be a need for climate change science to be communicated to existing primary and secondary teachers through professional development programs. Anecdotal evidence suggests that currently practicing teachers in Australia are not clear about climate change science to the extent needed to accurately communicate it to their pupils. It is important that such training explains both the science involved and the level of consensus among scientists that anthropogenic climate change is occurring. Prior research indicates that scientific consensus may be critical in influencing acceptance of scientific propositions [4].

Moreover, teachers must have adequate training in this area if they are to dispel myths about climate change that may, for example, discourage appropriate adaptation and mitigation behaviours. Climate change is also predicted with a great deal of certainty to increase the occurrence of floods, fires and droughts in Australia [3]. Communicating the risks of climate change is important to encourage preparedness for these types of natural hazards and to ensure that they do not develop into natural disasters. Tertiary educators must lead the way in providing ways to meet the needs of pre-service teachers in relation to climate change education at the point of entry to their career in teaching. This is critical in the wake of the current global environmental stresses, which are

exacerbated by climate change, and also to fulfil the aims declared by UNESCO (2005) [12], wherein the teacher's role is of paramount importance to support sustainable development.

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